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DEPARTMENT OF EPIDEMIOLOGY

Lorraine Alexander, DrPH
Acting Director of Education Program

Victor Schoenbach, PhD

George Jackson, MHA
Graduate Research Asst.

http://www.sph.unc.edu/courses/eric

VA ERIC
EPIDEMIOLOGIC RESEARCH & INFORMATION CENTER
Durham, North Carolina

Eugene Oddone, MD, MHSc
Acting ERIC Director

Beth Armstrong
ERIC Program Manager

http://hsrd.durham.med.va.gov/ERIC/

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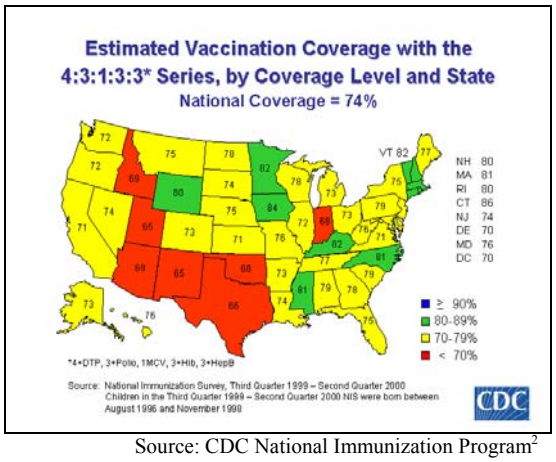
Health Care Epidemiology
Medical and Health Care Variation

One of the traditional beliefs in medicine is that two physicians presented with similar clinical situations will make similar decisions about diagnosis and treatment. However, this belief has been challenged during the last three decades. One of the principal reasons for changing beliefs about health care decision making has been the recognition of often significant variation in health care utilization that is not explained by clinical circumstances.[1] Health care epidemiology research can describe both the nature of variations and their impact on the health of populations.

Example of Health Care Variation



Source: CDC National Immunization Program[2]

Variations in medical care were brought to the attention of the wide scientific community by Wennberg and Gittelsohn in 1973.[3] They used a variety of data sources to examine variations in utilization in 1969 among 13 hospital service regions in Vermont. Large variations were observed in age-adjusted hospital and nursing home discharge and surgery rates among the different service areas. For example, probabilities of a child having a tonsillectomy by age 20 ranged from 16 to 66 percent.

The variations were present despite the fact that the 400,000 people of Vermont represented a relatively homogenous population living in a small geographic area. There was wide variation despite economic conditions being relatively consistent. Interpreting the variations, Wennberg and Gittelsohn state "there are a number of indications that there is uncertainty concerning the value of a given level of health care delivery" (p. 182-183).[3]

The sorts of variations found in 1973 persist. An analysis of 1996 Medicare data found that spending per enrollee varies more than two-fold across different regions of the country. The variations persisted after adjustment for age, sex, race, and health status of the region's enrollees. The spending differences were driven by "supply-sensitive" services such as physician visits, specialty consultations, and hospitalizations. Medicare spending was not associated with longer life expectancy (a measure of outcome) or use of commonly recommended preventive or chronic illness services (a measure of care effectiveness).[4]

Variation in the VA

Until the mid-1990's, there was a question as to whether significant variation in medical care utilization occurs within the Veterans Affairs (VA) health care system. The VA has a central administration, uses salaried physicians, and predominantly serves men of lower socioeconomic status than the general population.[5] As a result, it would be reasonable to hypothesize that one would not observe the great variation in utilization that has been consistently observed since the publication of the 1973 paper by Wennberg and Gittelsohn.[6]

Ashton, et al.[5] used national VA databases to determine if utilization varied among the 22 regions that were established as Veterans Integrated Service Networks (VISNs) in 1995. After risk adjustment, the authors compared the inpatient discharge rates, average number of hospital days per patient per 12 month period, and outpatient visit rates from FY 1991-FY 1995 for eight conditions: chronic obstructive pulmonary disease, pneumonia, congestive heart failure, angina, diabetes, chronic renal failure, bipolar disorder, and major depression. Significant variations were found for all eight conditions in all years studied. For example, outpatient visit rates varied by factors ranging from 1.6 to 4.0. Regions with high utilization rates for one condition tended to have high

utilization rates for other conditions. Higher utilization rates tended to be in the Northeast and lower rates tended to be in the West.

Ashton and colleagues dismiss differences in health status as a reason for the variation because of the relative homogeneity of the patients served by the VA. They also dismiss financial incentives because physicians and other providers are salaried and allocation formulas are uniform across the system. They credit regional differences in practice standards.[5] However, in an accompanying editorial, Wennberg argues that other studies point to significant variations in practice patterns within geographic areas far smaller than the VISNs.[6]

Availability of resources was associated with greater VA inpatient utilization. Variation in the number of VA hospital beds per veteran accounted for 32-58 percent of the variation in hospital days. Information on the potential association between outpatient resources and utilization was not presented.[5]

Reliability and Validity – Why Variation Matters

Variation in the utilization of health care services and related decision making is a measure of the reliability of the patient care management. Reliability is the degree to which results are replicated when an activity or procedure is repeated under the same conditions.

The problem with health care variations relates to the relationship between reliability and validity. While validity has a variety of definitions depending on the context, the core component is whether something is correct. In the case of a measurement tool, the question is whether the tool correctly captures what it is intended to measure. In the case of clinical care, validity concerns whether the care plan is the one that leads to the best possible outcomes.

If something is reliable, it is not necessarily valid. For example, every physician could prescribe the same ineffective plan of care. There would be no variation (i.e. perfect reliability), but there would also be questionable validity. This situation would reflect strongly-held, widely-accepted, but incorrect beliefs about an inappropriate treatment. Addressing such situations is the reason for health care research, including epidemiology studies.

Variation in care that is not related to the clinical situation is a problem because validity can not exceed reliability.[7] We almost always lack complete knowledge of how best to care for a particular condition. Because a clinician must still prescribe a course of care, we expect variation in what is done. However, attempting to use what we do know to develop care plans can help reduce additional unnecessary variation. Reducing this variation can increase the probability that an individual patient's care will be the most valid possible.

Risk Adjustment

When comparing utilization and potentially related outcomes across geographic regions, populations, organizations, locations, providers, etc., we must account for the fact that different types of patients and systems may be under comparison. Care plans and outcomes are appropriately influenced by patient attributes (e.g. social situation, physiologic reserve, disease characteristics) and health system characteristics (e.g. available equipment). As a result, utilization patterns may not be directly comparable because of differences in patients or health systems. It is necessary to take expected variations into account when investigating variations in care.

This process is accomplished by risk adjustment. The goal of risk adjustment "is to control for factors that patients independently bring to health care encounters that can affect their likelihood of experiencing good or bad outcomes"(p. S8).[8] These potential confounders need to be controlled for in the same way one would control for potential confounders in an etiologic study.

Variation in Decisions

In order to provide personal health services, it is necessary for a clinician to make a diagnosis and chose a management plan. Various components of the decision-making process can affect both expected and unexpected variations in care. Thus, the decision-making process is an important part of health care epidemiology studies concerning variations in health care and subsequent outcomes.

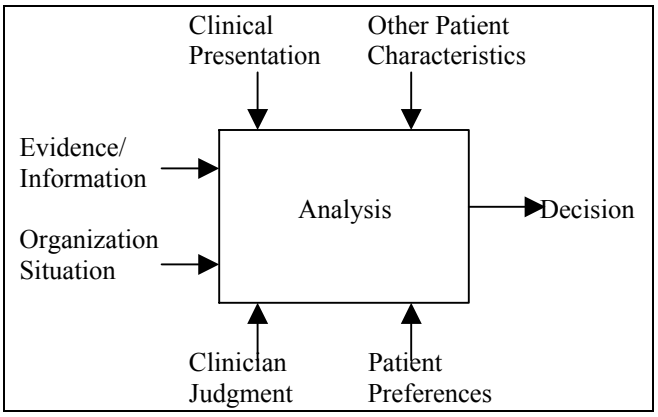
The two basic functions in decision making are collecting and interpreting data. The clinician obtains information (e.g. medical history, family history, physical exam, diagnostic test results) and processes that information to make a prediction about diagnosis and treatment.[9] In a perfect world, clinicians would have access to the same clinical findings, have perfect knowledge of the meaning of those findings, process the information in the same way, and come to the same conclusion. All variation in care would result from differences in clinical features, patient preferences, and available resources.[11] In actual practice, clinical decision making does not occur in a consistent manner.

Differences in Diagnostic Information. During the diagnostic process, novice practitioners often form hypotheses and then seek information to confirm or reject these hypotheses. In very complex cases, experienced practitioners may do the same thing.[12] The initial hypotheses, and often the resulting diagnosis, may be influenced by such factors as when and where the clinician was trained and the individual's experience.

For expert practitioners, the decision-making process is typically one of pattern recognition or direct automatic retrieval.[12] Differential access to diagnostic information can lead to apparently different patterns, and hence different initial diagnosis. Difficulty diagnosing patients' problems can lead to variations in care.

Incomplete Information on Conditions and Treatments. Notwithstanding the burgeoning literature on the distribution, causes, and treatment of disease, injury, and illness, diagnosis and treatment decisions are often made in the face of considerable uncertainty. Many treatments (e.g. pharmaceuticals, procedures) can be used in different combinations for the same condition. Patient characteristics or the skill of the clinician may affect the utility of these treatments. The necessity to act without definitive guidance invites variation in care.[11]

Clinical Decision-Making Process



Processing Information — Clinical vs. Actuarial Decision Making. In 1954, Paul Meehl brought the issue of clinical versus actuarial (also termed statistical, mechanical, and algorithmic) decision making to a broad scientific audience.[13] Clinical decision making is the process of combining information in one's mind to make a decision. Actuarial decision making involves making conclusions on the basis of empirically established relationships between data and the condition of interest.[10] Examples of such tools include regression equations and actuarial tables.[14] Unlike clinical decision making, an actuarial decision tool will lead to the same conclusion every time the same information about the same person is inputted into the decision tool. Actuarial decision making eliminates human judgment at the point the decision is being made.[10, 14]

Research over the last 70 years has almost uniformly found that actuarial decision making equals or surpasses the accuracy of clinical decision making. Actuarial decision making also has less variability. In a review of 617 comparisons in 136 studies published between 1920 and 1994, Grove, et al. found only eight comparisons in which clinical decision making surpassed the accuracy of actuarial decision making.[15]

There are several factors that may account for the superiority of actuarial decision making. These include:

- For a given data set, actuarial decision making always leads to the same conclusion.[10] As previously noted, the increase in reliability increases the potential upper bound of validity.
- The clinician's experience does not come from a truly representative sample of the population. As a result, his or her perception of the relationship between variables is not representative.[10] Similarly, it has long been recognized that special attention must be paid to the generalizability of epidemiologic studies using hospitalized patients because the patients may be different from nonhospitalized people.[16]
- People tend to overestimate the frequency of unusual and easily recalled events. Hence, clinicians over emphasize rare conditions when making clinical judgments. This is known as the availability heuristic.[12]
- Clinicians often ignore base rates. They may consider each hypothetical diagnosis equally likely because they are looking at how close a particular case is to a diagnostic category or previously seen cases. This is termed the representativeness heuristic.[12]
- People tend to overweigh small probabilities and underweigh large probabilities.[12]
- Clinical decision making is prone to fluctuations in judgment.[10] For example, information presented later in the decision process is typically weighted more than earlier information. Further, subjective probability of a scenario is often overestimated if a description of the scenario appears more detailed than other alternatives.[12]
- The human brain is not efficient at noticing, selecting, categorizing, retaining, retrieving, and manipulating information for the purpose of making inferences.[14]
- People often develop incorrect beliefs about associations between variables.[10]
- Past predictions are generally recalled as being more accurate than they were, inflating the decision maker's assessment of his or her decision making ability.[10]
- People are more likely to attend to information that supports an initial hypothesis.[10]

The above list is presented to demonstrate the wide variety of issues that may lead to variations in clinical decision making. Despite recent efforts to introduce more decision rules, clinical pathways, algorithms, and evidence-based guidelines to the practice of medicine and other clinical professions, clinical

decision making remains the primary way in which information is processed during the health care decision-making process. Although the lack of algorithmic decision making increases variation, traditional clinical decision making cannot be eliminated from health care practice. Reasons why such human judgments are necessary include:

- Humans can notice significant exceptions that may call into question actuarial conclusions. Psychologists call this the "broken-leg" scenario. The classic illustration is that a person who is predicted by an actuarial formula to attend a weekly movie does not. The actuarial formula should be disregarded because the person is in a cast as a result of a broken leg, preventing him from attending the movie. In other words, people can recognize the infinite number of potential rare events that cannot be included in an actuarial formula. The difficulty is that people often mistakenly think they are seeing exceptions, when they are not.[10]
- Any actuarial formula, like clinical-decion process, will lead to false positives and false negatives. Clinicians may need to adjust decision model cutoffs depending on judgments about the relative consequences of false positives and false negatives.
- When an actuarial formula does not predict the correct diagnosis or action, the clinician must test other hypotheses as to the correct diagnosis or treatment plan.
- Clinicians can work with patients to make decisions based on individual preferences.[17]

Types of Health Care Variation Comparisons

Although geographic variation (also referred to as small area variation) is the most commonly discussed form of health care variation, variation can be studied in relation to many different factors. Below is list of some of the most common comparisons.

- **Geographic –** The terms *health care or medical care variation* are often considered to be synonymous with geographic variations such as those described in the 1973 Wennberg and Gittelsohn[3] paper and the Ashton et al.[5] analyses of variations in the VA health system. Geographic variations may occur between countries, states, counties, cities, regions designated by natural boundaries (e.g. rivers), or any other geographic entity. Important research questions concern why variations are observed.
- **Urban-Rural –** Numerous studies have indicated that the care received in rural settings differs from that received in urban settings[18], including within the VA.[19] This type of geographic variation may be the result of differences in such areas as population health status, demographics, culture, access to services, and public policies.[18]
- **Organizations –** Care can vary among different organizations (e.g. managed care organizations). Variations in the provision of important services may represent differences in organizational structure and resources that can affect quality of care and patient outcomes.[20] This is the reason for efforts such as the Health Plan Employer Data and Information Set (HEDIS) program operated by the National Committee on Quality Assurance (NCQA).[21]
- **Individual Providers or Practice Teams –** Even in cases where well established evidence points to best care practices, individual providers do not always provide care consistent with that evidence.[22] Variations in care provided by individual clinicians may indicate areas for potential quality improvement.
- **Socioeconomic Status –** Variations can also be studied in relation to patient characteristics. Differences have been observed in care provided to people of different socioeconomic status. Potential explanations for such variations include differences in ability to pay, physical access to care, education, knowledge, literacy, health beliefs, patient preferences, and racial concordance between patents and providers.[23]
- **Race/Ethnicity –** Numerous studies have indicated variations in care provided to people of different races and ethnicities.[24] Alternative explanations for these differences include differences in clinical presentation (appropriate variation)[25], ability to pay (socioeconomic status)[25], patient preferences[25], overt racism[24], and more subtle biases[24].
- **Gender –** Based on the fact that the health needs and clinical issues of males and females differ, a degree of health care variation would be expected between genders. However, differences in care do not always relate to clinical presentation. Gender differences may reflect issues such as care preferences or clinician attitudes.[26]

Conclusion

Over the past three decades, numerous studies have indicated variations in the health care services provided to people who live in different places, receive care in different settings, and have different characteristics. Some of this variation would be expected and is appropriate. However, much of the variation can not be explained by clinical or resource issues that one would expect to lead to different care. Epidemiologic and health services research on the nature of the variations, their impact, and ways to reduce inappropriate differences is an important ingredient in efforts to improve health care quality.

Helpful Web Sites

Association of American Geographers-
Medical Geography Specialty Group
http://www.pop.psu.edu/aag/mgsg.html

Dartmouth Atlas of Healthcare
http://www.dartmouthatlas.org/

HRSA-Area Resource File
http://www.arfsys.com/

Kaiser Family Foundation-State Health Facts Online
http://www.statehealthfacts.kff.org/

National Committee on Quality Assurance
http://www.ncqa.org/

National Rural Health Association
http://www.nrharural.org/

North Carolina Rural Health Research and Policy Analysis Cartographic Archive
http://www.shepscenter.unc.edu/RESEARCH_PROGRAMS/RURAL_PROGRAM/maps/maps.html

Dept. of Health and Human Services-Office of Minority Health
http://www.omhrc.gov/

VA-Center for the Study of Healthcare Provider Behavior
http://www.va.gov/hsrd/about/centers/provider_behavior/default.html

VA-Information Resource Center
http://www.virec.research.med.va.gov/

VA-Quality Enhancement Research Initiative
http://www.hsrd.research.va.gov/research/queri/

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BETH ARMSTRONG, ERIC PROGRAM MANAGER
VA MEDICAL CENTER (152)
508 FULTON STREET
DURHAM, NC 27705